WHAT IS CLAIMED IS:

1. A method for forming a trench structure comprising the steps of:
providing a substrate;
forming a mask layer of a predetermined pattern on the substrate to expose a portion of the substrate;
forming a first trench in the exposed portion of the substrate, the first trench having a first depth;
forming a first protection layer on the surfaces of the whole structure;
forming a second trench in the first trench downward, the second trench having a second depth greater than the first depth;
forming a second protection layer on the surfaces of the whole structure; and
forming a third trench in the second trench downward, the third trench having a third depth greater than the second depth.
2. The method as claimed in Claim 1, wherein the first depth is substantially equal to the junction depth of a transistor adjacent to the first trench and formed subsequently.
3. The method as claimed in Claim 1, wherein the first depth is greater than 100 nm.
4. The method as claimed in Claim 1, wherein the first protection layer comprises a nitride layer.
5. The method as claimed in Claim 1, wherein the second depth is greater than 700 nm.
6. The method as claimed in Claim 1 further comprising the steps of
removing a portion of the substrate on the surface of the second trench; and
forming an oxide layer on the surface of the second trench,
after the step of forming the second trench.
7. The method as claimed in Claim 1, wherein the second protection layer comprises a nitride layer.
8. The method as claimed in Claim 1, wherein the sum of the first, the second, and the third depths is greater than 7 μm.
9. A method for forming a trench capacitor comprising the steps of:
providing a substrate;
forming a mask layer of a predetermined pattern on the substrate to expose a portion of the substrate, the mask layer comprising an oxide layer;
forming a first trench in the exposed portion of the substrate, the first trench

having a first depth;

forming a first protection layer on the surfaces of the whole structure;

forming a second trench in the first trench downward, the second trench having a second depth greater than the first depth;

forming an insulation layer on the surface of the second trench;

forming a second protection layer on the surfaces of the whole structure;

forming a third trench in the second trench downward, the third trench having a third depth greater than the second depth;

forming a conductive diffusion region in the substrate of the periphery of the third trench;

removing the first protection layer and the second protection layer;

forming a dielectric layer on the surfaces of the overall structure;

filling all trenches with a first conductive layer, and making the height of the first conductive layer greater than the bottom of the oxide layer of the mask layer;

removing the oxide layer of the mask layer;

removing a portion of the first conductive layer to make the height of the left first conductive layer greater than the bottom of the insulation layer on the surface of the second trench; and

removing the dielectric layer not covered by the first conductive layer.

10. The method as claimed in Claim 9 further comprising the step of removing a portion of the substrate on the surface of the second trench, after the step of forming the second trench.
11. The method as claimed in Claim 9, wherein the insulation layer on the surface of the second trench is an oxide layer.
12. The method as claimed in Claim 11, wherein the oxide layer is formed by heat treatment.
13. The method as claimed in Claim 9 further comprises the step of removing a portion of the substrate on the surface of the third trench, after the step of forming the third trench.
14. The method as claimed in Claim 9, wherein the conductive diffusion region is formed by Arsenic Silicon Glass (ASG) and heat treatment.
15. The method as claimed in Claim 9, wherein the dielectric layer comprises a nitride layer.
16. The method as claimed in Claim 9, wherein the first conductive layer comprises a polysilicon layer.
17. The method as claimed in Claim 9 further comprising the steps of

forming a third protection layer on the surfaces of the first trench and the second trench not covered by the first conductive layer to make its height lower than the surface of the substrate; and

forming a second conductive layer on the first conductive to make its height equal to the third protection layer,

after the step of removing the dielectric layer not covered by the first conductive layer.

18. The method as claimed in Claim 17, wherein the third protection layer comprises a nitride layer.
19. The method as claimed in Claim 17, wherein the second conductive layer comprises a polysilicon layer.